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<b>(21) International Application Number:</b> PCT/US96/11086 <b>(22) International Filing Date:</b> 27 June 1996 (27.06.96) <b>(30) Priority Data:</b> 08/495,919 28 June 1995 (28.06.95) US <b>(71) Applicant:</b> HUYCK LICENSCO, INC. [US/US]; Suite 1300, 1105 North Market Street, Wilmington, DE 19801 (US). <b>(72) Inventors:</b> GSTREIN, Hippolit; Graben 25, A-2640 Gloggnitz (AT). MICHALEK, Walter; A-2630 Pottschach (AT). <b>(74) Agent:</b> SAUNDERS, Thomas, M.; Lorusso & Loud, 440 Commercial Street, Boston, MA 02109 (US).		<b>(81) Designated States:</b> AM, AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LT, LU, LV, MD, MG, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TT, UA, UG, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).  <b>Published</b> With international search report.
<b>(54) Title:</b> PROCESS OF MAKING PAPERMAKERS' FABRIC  <b>(57) Abstract</b>  A process for producing a papermakers' fabric, wherein the paper contacting surface of the fabric is molded between two preferably heated surfaces adapted to apply contact pressure to the fabric to optimally smoothen the paper contacting surface of the fabric and equalize caliper variations in the fabric. Preferably the two surfaces are surfaces of two cooperating rolls formed in a nip press. The fabric is passed through the nip press into engagement with the heated rolls thereby molding and smoothening the surface of the fabric.  <p style="text-align: right;">P7 onward.</p> <p>No: Moisture Differential pressure across width. Specific disclosure of sieve properties... void size etc Pressure adjustment for joined fibres at joint</p>		

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## PROCESS OF MAKING PAPERMAKERS' FABRIC

1     **Field of the Invention**

2             The present invention relates to papermakers' fabrics and  
3     especially to papermaking fabrics for the dryer or forming  
4     sections of a papermaking machine.

5

6     **Background of the Invention**

7             In the conventional fourdrinier papermaking process, a water  
8     slurry or suspension of cellulose fibers, known as the paper  
9     "stock", is fed onto the top of the upper run of a travelling  
10    endless forming belt. The forming belt provides a papermaking  
11    surface and operates as a filter to separate the cellulosic  
12    fibers from the aqueous medium from the cellulosic fibers by  
13    providing for the drainage of the aqueous medium through its mesh  
14    openings, also known as drainage holes, by vacuum means or the  
15    like located on the drainage side of the fabric.

16            After leaving the forming medium the somewhat self-  
17    supporting paper web is transferred to the press section of the  
18    machine and onto a press fabric, where still more of its water  
19    content is removed by passing it through a series of pressure  
20    nips formed by cooperating press rolls, these press rolls serving  
21    to compact the web as well.

22            Subsequently, the paper web is transferred to a dryer  
23    section where it is passed about and held in heat transfer  
24    relation with a series of heated, generally cylindrical rolls to  
25    remove still further amounts of water therefrom by evaporation.  
26    Dryer fabrics are used in the dryer section of papermaking

1 machinery to support the moist paper web as it encounters the  
2 heated rolls. Typically, the dryer fabric is formed into a  
3 conveyor belt-like shape and incorporates at least a woven base  
4 fabric with a smooth top surface for contacting the paper web.

5 The surface of the dryer fabric is determinative of the  
6 marking characteristics found on the paper. If the surface of  
7 the dryer fabric is smooth, the contact paper web will exhibit  
8 less marking, thereby resulting in high quality paper. In  
9 addition, a dryer fabric with a uniform and smooth surface  
10 provides increased contact area between the web and the heated  
11 rolls of the dryer section, thereby increasing the heat transfer  
12 between the heated rolls of the dryer section and the paper web  
13 and leading to more efficient sheet dewatering.

14 Thus, it has been a goal of the papermaking industry to  
15 produce dryer fabrics with a smooth and uniform paper contacting  
16 surface. The standard method for producing a dryer fabric with  
17 these characteristics has been to provide a high fabric density  
18 with weave patterns having long machine or cross machine  
19 direction floatings. Another approach has been to form the dryer  
20 fabric from flat monofilament materials in the machine direction  
21 of the fabric.

22 Despite the attempts of the prior art, however, knuckles  
23 formed at the crossing of the machine and cross machine direction  
24 yarns invariably render the fabric prone to contamination and  
25 marking, and prevent uniformly high heat transfer. Using flat  
26 monofilaments has improved the heat transfer between sheet and  
27 dryer roll by increasing contact area, but forms large  
28 contamination traps according to the shape of the monofilament.

1 Thus, various impurities become trapped within these fabrics  
2 causing highly undesirable marking characteristics.

3 These difficulties exist similarly in the production of  
4 forming fabrics for the forming section of the papermaking  
5 machinery. Forming fabrics, however, generally cannot be  
6 manufactured with a high fabric density since large interstices  
7 between fabric yarns must exist to ensure drainage of the aqueous  
8 medium through the fabric. Thus, surface smoothness is achieved  
9 in forming fabrics primarily by providing long floats on the  
10 paper contacting surface of the fabric, and by performing various  
11 grinding and treating methods. Invariably, however, knuckles  
12 formed on the papermaking surface cause the forming fabrics to  
13 suffer from the same deficiencies as discussed above in  
14 connection with dryer fabrics.

15

#### 16 **Summary of the Invention**

17 Therefore, one object of the present invention is to provide  
18 an improved papermakers' fabric for use in the forming or dryer  
19 section of the papermaking machine.

20 Another object of this invention is to provide a  
21 papermakers' fabric having an improved surface, resulting in  
22 better sheet quality.

23 Yet another object of the present invention is to provide  
24 a papermakers' dryer fabric with an improved drying rate due to  
25 improved contact between the paper web and the rolls of the dryer  
26 section.

1           Still another object of the present invention is to provide  
2   a papermakers' dryer fabric with less opportunity for  
3   contamination due to missing knuckles.

4           These and other objects of the invention are achieved by a  
5   process for producing a papermakers' fabric, wherein the paper  
6   contacting surface of the fabric is molded between two preferably  
7   heated surfaces adapted to apply contact pressure to the fabric  
8   to optimally smoothen the paper contacting surface of the fabric  
9   and equalize caliper variations in the fabric. Preferably the two  
10   surfaces are the surfaces of two cooperating rolls formed in a  
11   nip press. The fabric is passed through the nip press into  
12   engagement with the heated rolls thereby molding and smoothening  
13   the surface of the fabric.

14

#### 15   **Brief Description of the Drawing**

16           The process for manufacturing fabrics according to the  
17   present invention will be apparent from the following detailed  
18   description of the invention, along with the drawings, in which  
19   like reference numbers refer to like members throughout the  
20   various views.

21           FIGS. 1-3 are unity textile design charts for illustrating  
22   preferred embodiments of a dryer fabric for use in connection  
23   with the present invention.

24           FIGS. 4-8 are machine direction sectional views of preferred  
25   embodiments of a forming fabric for use in connection with the  
26   present invention.



1           FIG. 9 is a diagram of a preferred system for performing a  
2   surface molding operation on a papermaker's fabric according to  
3   the present invention.

4

#### 5   **Detailed Description of the Invention**

6           Generally, the invention relates to the manufacturing and  
7   application of papermaker's fabrics for the forming or dryer  
8   sections of a paper machine involving the step of surface molding  
9   the fabric between heated surfaces to obtain an optimally uniform  
10  paper contacting surface.

11           The fabrics manufactured according to the present invention,  
12  as do most papermakers' fabrics, incorporate a woven fabric,  
13  being either single or multilayer, e.g. monoplane, duplex, X-  
14  weave, triple weft or triplex. The weave patterns and materials  
15  for the fabric will be selected according to criteria such as  
16  smoothness of the fabric surface against the sheet side and/or  
17  wear resistance against the rolls.

18           FIGS. 1-3 are design charts which illustrate preferred weave  
19  patterns for dryer fabrics which are particularly useful in  
20  connection with the present invention. In these figures, Arabic  
21  numerals 1-13 denote cross machine direction yarns, and numerals  
22  13-18 denote machine direction yarns. The symbols "X" denote  
23  locations where cross machine direction yarns are positioned over  
24  machine direction yarns, giving long machine direction floats.  
25  FIGS. 4-8 are machine direction sectional views of preferred  
26  forming fabrics for use in connection with the present invention  
27  wherein the machine direction yarns 19-20 are interwoven with  
28  cross machine direction yarns 21-24.

1           As can be seen, the preferred weaves include long machine  
2           direction yarn floats, i.e. machine direction yarns which travel  
3           over two or more successive cross machine direction yarns without  
4           diving back down into the fabric.       FIGS. 1-8 represent  
5           preferred, but not limiting weave patterns for dryer and forming  
6           fabrics. The fabrics depicted in FIGS. 1-3 demonstrate preferred  
7           weaves on either eight or twelve shaft. Different weave patterns  
8           are used to match different permeability ranges for the dryer  
9           fabrics according to their application in the warm-up, the main  
10          evaporation zone, or the cooling zone of the dryer. Similarly,  
11          different weave patterns for the forming fabrics may be used  
12          according to predetermined criteria.

13          The conventional yarns utilized in dryer and forming fabrics  
14          of the present invention will vary, depending upon the desired  
15          properties of the fabric. Round shaped polyester-monofilaments  
16          with diameters of 0.3mm to 0.6mm represent the preferred material  
17          for the standard dryer fabric. Polyester and polyamide  
18          monofilaments with diameter of 0.08mm to 0.4mm represent the  
19          preferred material for standard forming fabrics. Nonetheless,  
20          the yarns may be round, elliptic, or flat, and may be  
21          multifilament yarns, monofilament yarns, twisted multifilament  
22          and/or monofilament yarns, spun yarns or any combination of the  
23          above. It is within the skill of those practicing in the  
24          relevant art to select a yarn type, depending on the purpose of  
25          the fabric, to utilize with the concepts of the present  
26          invention.

27          Yarns selected for use in each layer of the woven dryer or  
28          forming fabric of the present invention may be those commonly



1 used in dryer fabric or forming fabric base fabric layers. For  
2 example, the yarns could be ryton, peek, cotton, wool,  
3 polypropylenes, polyesters, aramids or polyamides or combinations  
4 of these materials. Again, one skilled in the art will select  
5 a yarn material according to the particular application of the  
6 final composite fabric.

7 After weaving and joining, the dryer or forming fabrics of  
8 the present invention are subjected to a finishing process.  
9 Referring to FIG. 9, during the preferred finishing process, the  
10 fabric 27 is surface smoothened by molding between two rolls 25,  
11 26 configured in a nip press. At least one, preferably both  
12 rolls 25,26 are heated by either a steam or oil source (not  
13 shown). Also, in the preferred embodiment the rolls 25, 26 are  
14 swimming rolls which provide uniform pressure and heat transfer,  
15 giving the fabric a uniformly molded surface. In the molding  
16 process, the fabric 27 is warmed on a heated roll(s) 25,26,  
17 passed through the nip press formed by the rolls, and cooled.  
18 This process is iteratively performed while continuously checking  
19 caliper, permeability and imprints of the fabric surface to meet  
20 desired specifications for the fabric.

21 Different fabric designs require specific molding procedures  
22 which differ in temperature, loading, dwell time, passes, etc.  
23 to obtain optimum surface smoothness. However, one pass of the  
24 fabric between two rolls configured in a nip press at a  
25 temperature of 150 °C, at a speed of 0.7 m/min and a loading of  
26 20-150 kp/cm<sup>2</sup> represents a useful starting point. Nonetheless,  
27 the optimum parameters will always depend on the type of fabric  
28 used and the desired criteria for the final fabric. It has been

1 found, however, that the temperature used for the process is  
2 typically between about 130 °C and about 240 °C. The speed at  
3 which the fabric is passed through the rolls varies depending on  
4 the design between 0.3 and 10 m/min. Likewise, the specific  
5 loading used for the molding process varies between about 20  
6 kp/cm<sup>2</sup> and 150 kp/cm<sup>2</sup>. Typically, the fabric must be passed  
7 through the rolls up to 10 times to meet the desired fabric  
8 specifications.

9 In addition, although the preferred embodiment involves the  
10 use of two heated rolls 25,26 it is also possible to heat only  
11 one roll 25 or to use only one roll to press the fabric against  
12 a flat plate (not shown) with either or both of the surfaces  
13 being heated. Other variations are also possible as long as  
14 contact pressure and heat are applied to the fabric between two  
15 surfaces.

16 Thus, the described process provides a molded fabric  
17 surface having optimum uniformity. In addition, caliper  
18 variations which exist in prior art fabrics are egalized down to  
19 the micro-scale and prominent fabric knuckles are eliminated.  
20 Thus, a fabric having a molded surface according to the present  
21 invention provides improved paper quality, less contamination,  
22 and improved drying rates due to improved sheet/roll contact in  
23 the case of dryer fabrics.

24 While the invention has been particularly shown and  
25 described with reference to the aforementioned embodiments, it  
26 will be understood by those skilled in the art that various  
27 changes in form and detail may be made therein without departing  
28 from the spirit and scope of the invention. Thus, any

1 modification of the shape, configuration and composition of the  
2 elements comprising the invention is within the scope of the  
3 present invention. It is to be further understood that the  
4 instant invention is by no means limited to the particular  
5 constructions or procedures herein disclosed and/or shown in the  
6 drawings, but also comprises any modifications or equivalents  
7 within the scope of the claims.

1 What is claimed is:

2 1. A process for manufacturing a papermakers forming fabric or  
3 dryer fabric comprising:

4 providing a woven fabric of interwoven cross machine  
5 direction and machine direction yarns; and

6 molding a paper contacting surface of said fabric by passing  
7 said fabric between two surfaces adapted to apply contact  
8 pressure to said fabric, at least one of said two surfaces being  
9 a heated surface.

10

11 2. The process according to claim 1, wherein at least one of  
12 said two surfaces comprises a surface of a roll.

13

14 3. The process according to claim 2, wherein said roll is a  
15 swimming roll.

16

17 4. The process according to claim 1, wherein said two surfaces  
18 comprise surfaces of two cooperating rolls configured in a nip  
19 press, and said paper making surface is molded by passing said  
20 fabric through said nip press.

21

22 5. The process according to claim 1 wherein said paper  
23 contacting surface comprises long machine direction floats which  
24 cross over at least two of said cross machine direction yarns  
25 successively before descending between others of said cross  
26 machine direction yarns.

1     6. The process according to claim 1, wherein said at least one  
2     of said two surfaces is heated to a temperature between about 130  
3     °C and 240 °C.

4

5     7. The process according to claim 1, wherein said fabric is  
6     passed between said two surfaces at a speed between about 0.3  
7     m/min and 10 m/min.

8

9     8. The process according to claim 1, wherein said fabric is  
10    passed between said two surfaces at a specific loading between  
11    about 20 kp/cm<sup>2</sup> and 150 kp/cm<sup>2</sup>.

12

13    9. The process according to claim 1, wherein said two surfaces  
14    comprise surfaces of two cooperating rolls configured in a nip  
15    press, said rolls being heated to about 150 °C, and wherein said  
16    fabric is passed through said nip press at a speed of about 0.7  
17    m/min.

18

19    10. A process for manufacturing a papermakers forming fabric or  
20    dryer fabric comprising the steps of:

21        (1) providing a woven fabric of interwoven cross machine  
22        direction and machine direction yarns; and

23        (2) molding a paper contacting surface of said fabric by  
24        passing said fabric between two surfaces adapted to apply contact  
25        pressure to said fabric, at least one of said two surfaces being  
26        a heated surface;

27        (3) cooling said fabric;

1           (4) checking said fabric for compliance with desired  
2 specifications; and

3           (5) iteratively performing steps (2) through (4) until said  
4 fabric complies with said desired specifications.

5

6       11. A papermakers fabric manufactured according to the process  
7 of claim 1.

8

9       12. A papermakers fabric manufactured according to the process  
10 of claim 10.



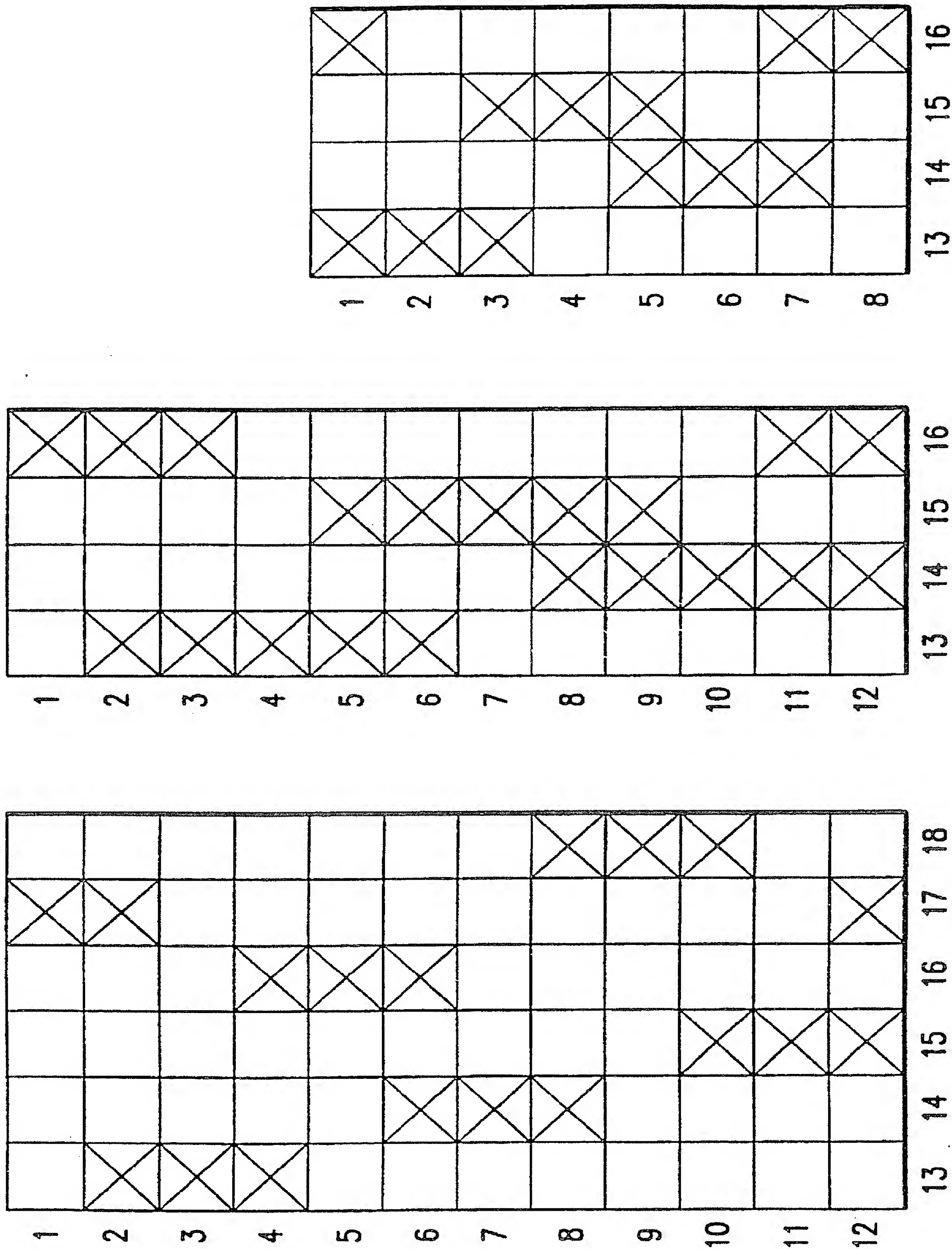


FIG.3

FIG.2

FIG.1

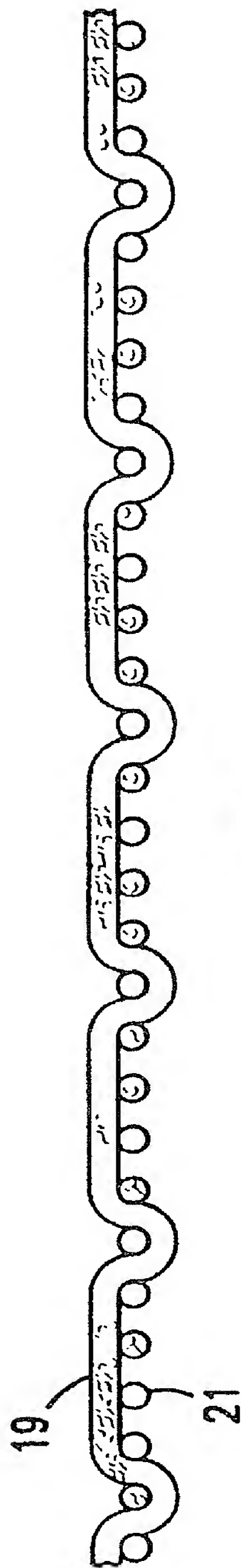


FIG. 4

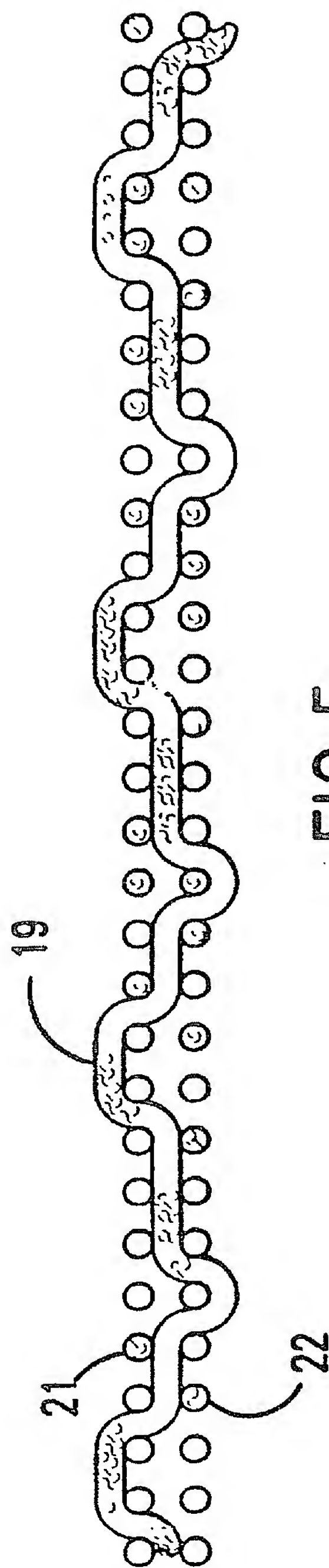


FIG. 5

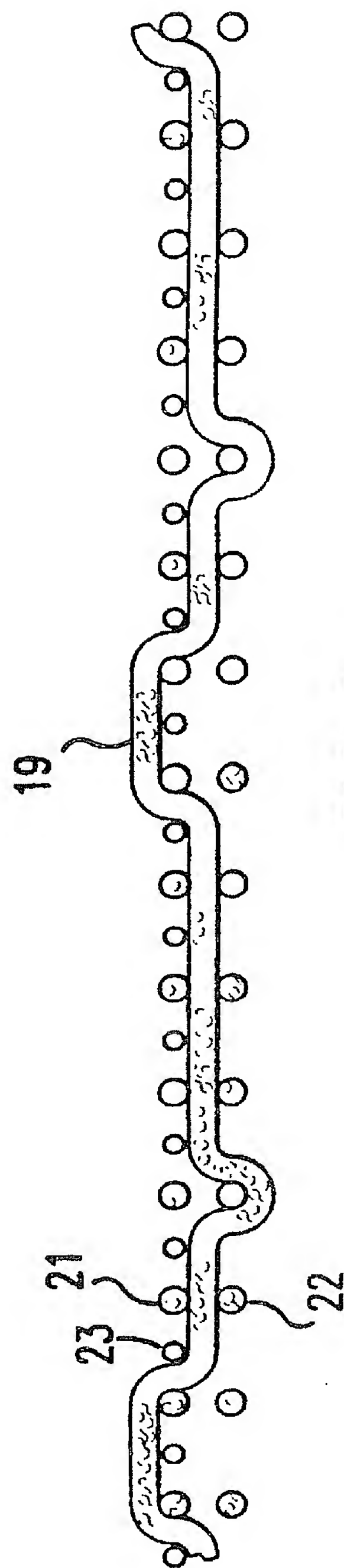
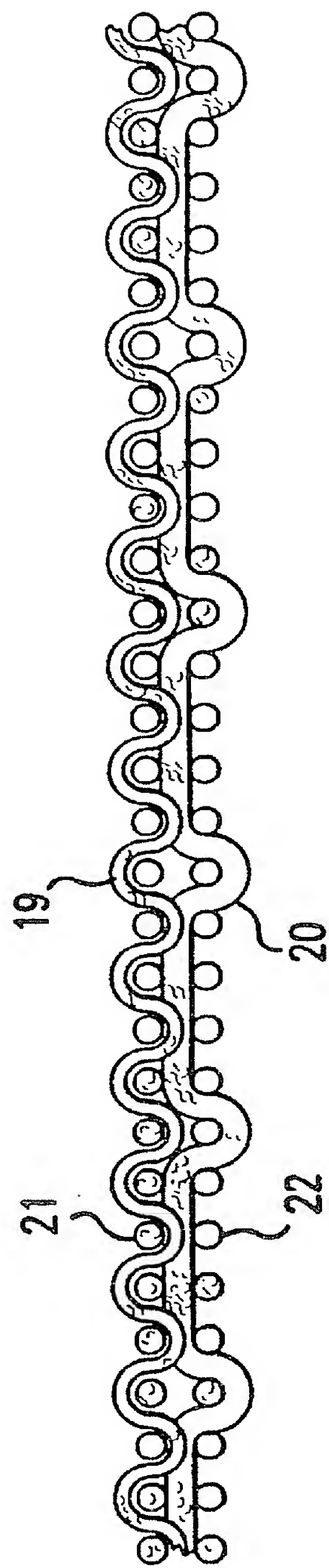
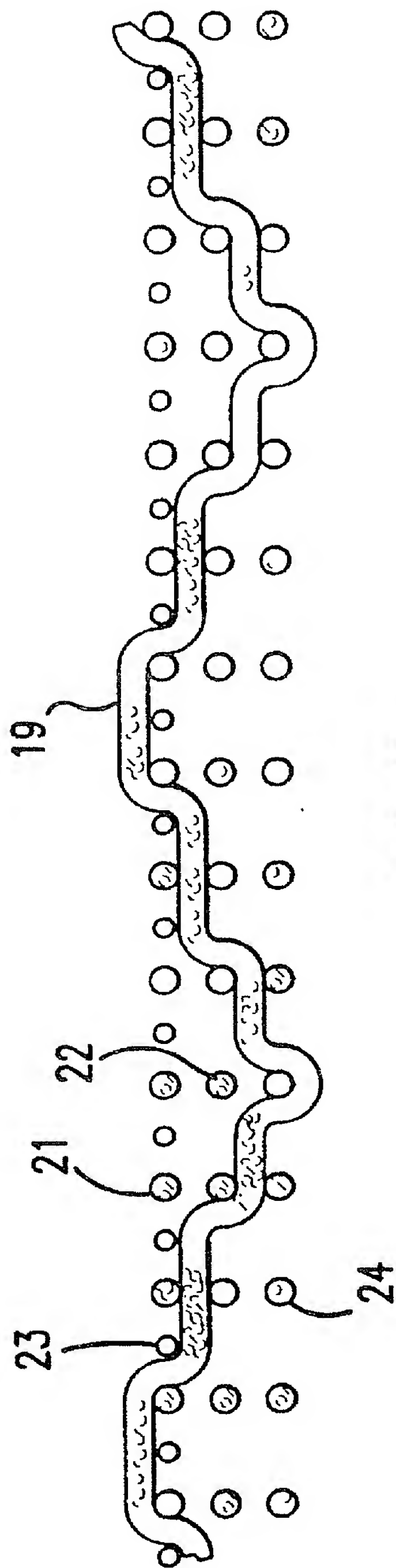


FIG. 6



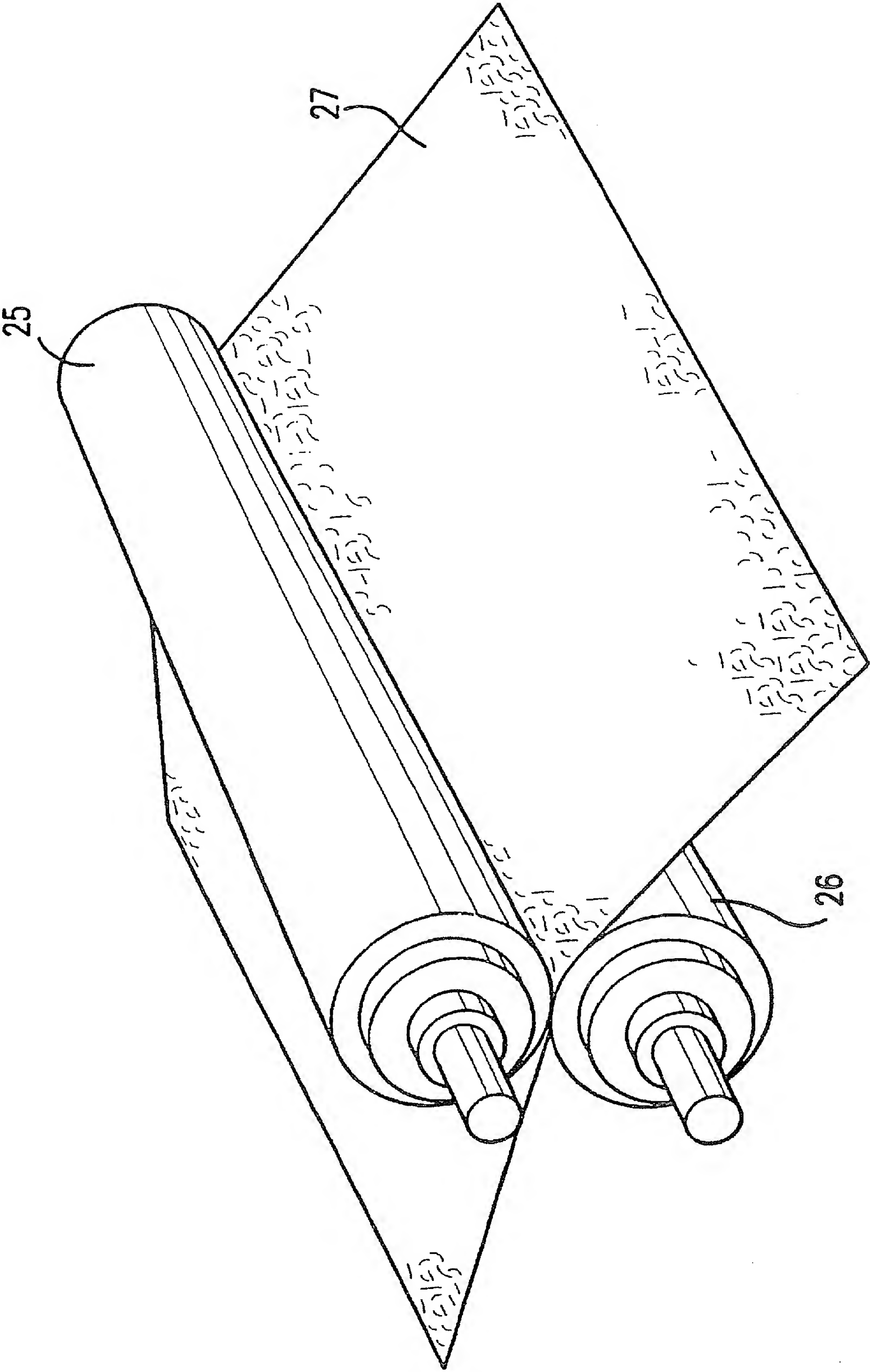


FIG. 9

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US96/11086

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :B29C 59/04

US CL :264/40.1, 280, 284; 428/224, 225

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
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NONE

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,407,737 A (W. HALTERBECK ET AL) 18 April 1995 (18.04.95), column 1, lines 5-34 and column 2, lines 12-51.	1-12

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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